

Memorandum

To: Mr. Gregory Stella

From: William Hodan, PES
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Date: September 28, 2001

Subject: EHIP Emissions Modeling Coordination Future Year Spatial Allocation – Preliminary Findings

Background

The current emissions inventory development methodologies result in area source emissions categories aggregated as either tons per year or tons per day at county levels. These emissions estimates are allocated to a regular grid cell pattern to be used as input to urban and regional air quality modeling analyses. Sub-county level data is available for certain types of activities thought to be associated with many major area sources of air pollutants. These sub-county level data are used to represent the corresponding distribution of emissions. These surrogate distribution files are referred to as Spatial Allocation Factor (SAF) files. Frequently, the same SAF files that were used to represent the emissions in the base year are applied to represent the future year scenarios. This essentially assumes that all growth and all increased activity is static. In reality, growth patterns shift in space over periods of years and decades.

Objective

The objective of this project is to explore options for estimating SAF files that could be used to represent future year conditions. To achieve this objective a list of the types of information that can be used to represent spatial variability of emissions sources is presented. Each of the different types of information will be reviewed to estimate the likelihood of finding adequate information to represent future distributions, and whether that information can be updated on a regular basis. A preliminary list of potential spatial factors is presented in Table 1.

The objective of this memorandum is to present the preliminary findings of the spatially relevant factors presented in Table 1. This memorandum presents a preliminary review and assessment of the relevant issues and potential data sources. An internet and literature search was conducted to research the availability of information about the potential spatial factors presented in Table 1. A full evaluation of the spatially relevant factors including the accuracy, representativeness, frequency of update, cost, and any other issues that would affect the use of the factors identified in the list has not been

completed. A list of recommendations is provided at the end of this memo explaining the steps that will be taken under the next work assignment to further evaluate these factors.

Table 1. Examples of Spatially Relevant Factors

Activity or Characteristic	Future Estimates Available	Potential for Regular Updates
Population	Y	Y
Urban Growth Plans (Smart Growth, etc.)	Y	Y
Employment in Various Sectors (See note 1)	Y	Y
New/Expansion Airport Construction	Y	?
Rail Traffic Patterns (including urban light rail)	Y	?
Shipping and Port Facilities	Y	?
Interstate Highway Construction	Y	Y
Major Highway Arterial Construction	Y	Y
Vehicle Registration	Y	Y
Agricultural Activities/Crop land (see note 2)	NA	NA
Agricultural Tilling/Field Burning Activities (see note 2)	NA	NA

Note 1: Examples of Important Sectors are: fossil fuel extraction, refining capacity, fuel distribution/marketing, printing/graphic arts, construction/demolition, forest products, manufacturing (durable goods, electronics, textiles, etc), chemicals production, pharmaceuticals production

Note 2: Agricultural Activities are not to be considered in this phase of the work.

Summary of Existing Spatial Factors

SAF files that are currently used to distribute emissions have been designed to work in conjunction with emission models such as the Regulatory Modeling System for Aerosols and Deposition (REMSAD) for particulate and visibility issues, the Urban Airshed Model (UAM) for ozone issues and Models-3/Community Multiscale Air Quality (CMAQ) modeling system for both particulate and ozone issues. Different factors are assigned to area and mobile source SCCs according to their relevance to the activity described. The Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system can handle particulate and VOC inputs. A list of spatial allocation files currently used with the SMOKE preprocessor are presented in Table 2. These files and other similar files assigned to REMSAD, UAM, and CMAQ modeling systems will be examined further for possible use in the assembly of a SAF file system to represent future year conditions.

Table 2. SAF File List Currently Used With the SMOKE Modeling System

Spatial Surrogate Assignment File	Number of Assignments to Area and Mobile SCCs
Agriculture	181
Airports	27
Land Area	17
Housing	210
Major Highways	3
Population	1614
Ports	72
Railroads	59
Water Area	25
Urban Primary Roads	180
Rural Primary Roads	135
Urban Secondary Roads	45
Rural Secondary Roads	90
Urban Population	45
Rural Population	349

Data Sources Identified

The literature and internet search for information pertaining to spatially relevant factors identified several potential sources of data that could be used to represent future year conditions. The information is categorized by the activity represented and references are included.

Population

The US Census Bureau has population projections by State in five-year increments through the year 2025. One way of projecting population at the county level using this data would be to take current county level population and ratio it to the desired future year using a State level ratio. This method of projection presents an obviously high level of error, since a State based ratio would not show the higher growth rates of cities or the effects of urban sprawl. The population changes would be rationed evenly over the entire State – urban and rural.

No information was found regarding future spatial projections at the county level or smaller, but some Metropolitan Planning Organizations maintain population data at the traffic analysis zone level.

US Census Bureau population projections:

<http://www.census.gov/population/projections/state/stpipop.txt>

Urban Growth Plans

Urban Growth (Smart Growth) Plans have been established for some cities in the United States such as Atlanta, Knoxville, and others. The goal of the plans is to reduce the spread of population into outlying areas in order to reduce pollution caused by longer commutes, conserve natural resources, and increase the efficiency of public services by concentrating public services in smaller areas. The measurement of the success of Urban Growth Plans is subjective, and no quantifiable future projections were located that would allow the results of the plans to be mapped out. Smart Growth Plans encourage populations and businesses to stay in cities by direct and indirect means by influencing policy. One source of data that may be able to supply data on urban growth plans is the State Office of Planning and Budget of each respective State. If the offices of States with large urban areas supply data on their individual urban growth plans, the results could be applied to future spatial emissions allocation.

The EPA is currently conducting an investigation of Smart Growth work at a national level. The EPA's Smart Growth and Communities webpage supplies information on issues related to Smart Growth, gives a regional breakdown of current programs, and links to relevant programs and topics.

<http://www.epa.gov/dced>

References to studies on spatial distribution relative to urban and rural areas have been compiled on a website maintained by Princeton University -
<http://popindex.princeton.edu/browse/v65/n1/c.html>

Additional relevant information:
<http://www.smartgrowth.org/>

Employment in Various Sectors

The US Department of Labor – Bureau of Labor Statistics provides national level projected employment statistics through 2008 categorized by job type, race, sex, etc.; but none of the projections identified have a spatial element. It will be necessary to locate employment statistics at a State or preferably county level to make use of factors of this type.

Bureau of Labor Statistics - Employment Projections Homepage:
<http://www.bls.gov/emphome.htm?H4>

New/Expansion Airport Construction

The US Department of Transportation and particularly the Bureau of Transportation Statistics could be used to obtain information concerning the future expansion of airports across the United States. Statistics on the expansion of the 50 largest airports between 1985 and 1995 are compiled by the Bureau of Transportation Statistics.

Reference for statistics on airport expansion:
<http://www.nonoise.org/library/air/airports.htm>

Rail Traffic Patterns (including urban light rail)

Information concerning the future use and expansion, or changes in rail traffic patterns could be obtained from the US Department of Transportation.

US Department of Transportation – Bureau of Transportation Statistics:
<http://www.bts.gov/>

Shipping and Port Facilities

Information concerning the future use and expansion, or changes in shipping and port facilities could be obtained from the US Department of Transportation.

US Department of Transportation – Bureau of Transportation Statistics:
<http://www.bts.gov/>

Interstate Highway Construction

Information concerning interstate highway construction could be obtained from the US Department of Transportation.

US Department of Transportation – Bureau of Transportation Statistics:

<http://www.bts.gov/>

Major Highway Arterial Construction

Information concerning the construction of major highway arteries could be obtained from the US Department of Transportation.

US Department of Transportation – Bureau of Transportation Statistics:

<http://www.bts.gov/>

Vehicle Registration

Information concerning future vehicle registration projections could be obtained from the US Department of Transportation.

US Department of Transportation – Bureau of Transportation Statistics:

<http://www.bts.gov/>

Recommendations and Next Steps

1. Explore ways that data sources can be combined to develop future spatial allocation factors. Population changes in urban areas are affected by urban growth plans; therefore the use of data based on combinations of data sources (e.g., population and urban growth plans) are more effectively used together to estimate future spatial factors.
2. Study other SAF file lists currently used to distribute emissions for REMSAD, UAM, CMAQ, and SMOKE to identify additional data sources that could be used effectively.
3. Contact the agencies identified in the literature search to gather more information on projection factors identified.